Modelling Root Growth with PDE. The C-root model.

Yves Dumont, Thierry Fourcaud, Emilie Peynaud
CIRAD, Umr AMAP, Montpellier, France
yves.dumont, thierry.fourcaud, emilie.peynaud@cirad.fr

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It is well known that roots are essential in plants life. They indeed insure essential functions as mechanical anchorage, water and nutrients uptake, ... However investigating root growth and development can be rather complex (in particular for trees) and modelling can be help-full not only as it helps formalizing knowledge but also designing new experiments and/or testing hypotheses. To this end, various models have been developed, most of them based on a complete and explicit representation of the root system, like Architectural or Functional-Structural Models. However, these models may be very complex, with many parameters to estimate. They may be also appropriate at the plant level, but not at the crop level, because of computational limitations.... That is why density based models, which describe the evolution of root or apex densities through space and time, have been developed (see for instance [2, 3] and references therein). In [3], a minimal continuous model was proposed, and applied to simulate the growth of several root system types, e.g. Eucalyptus lateral roots, or maize root systems. This model, called C-Root, is based on an Advection-Diffusion-Reaction family-like equations, similar to those considered to study insect dispersal [1]. Each operator in the model is related to a root growth process, such as primary growth, branching and mortality....

The aim of this talk will be to present the C-Root model and numerical simulations of root growth. We will also show parameters calibration is a difficult taskand needs a particular attention. Finally, we will discuss on-going investigations to couple our model to water and soil nutrients models [4], and to take into account roots competition.

References

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